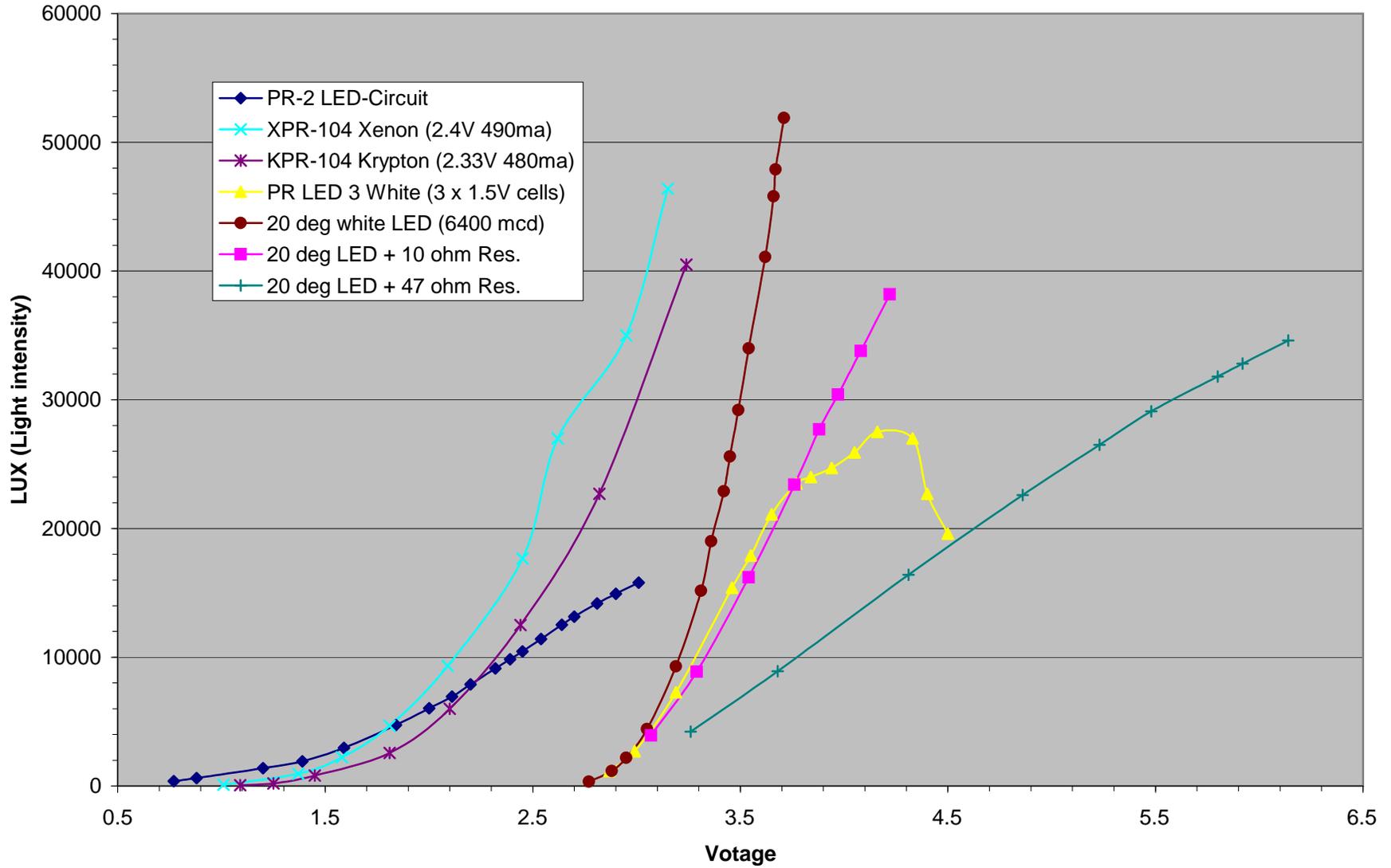
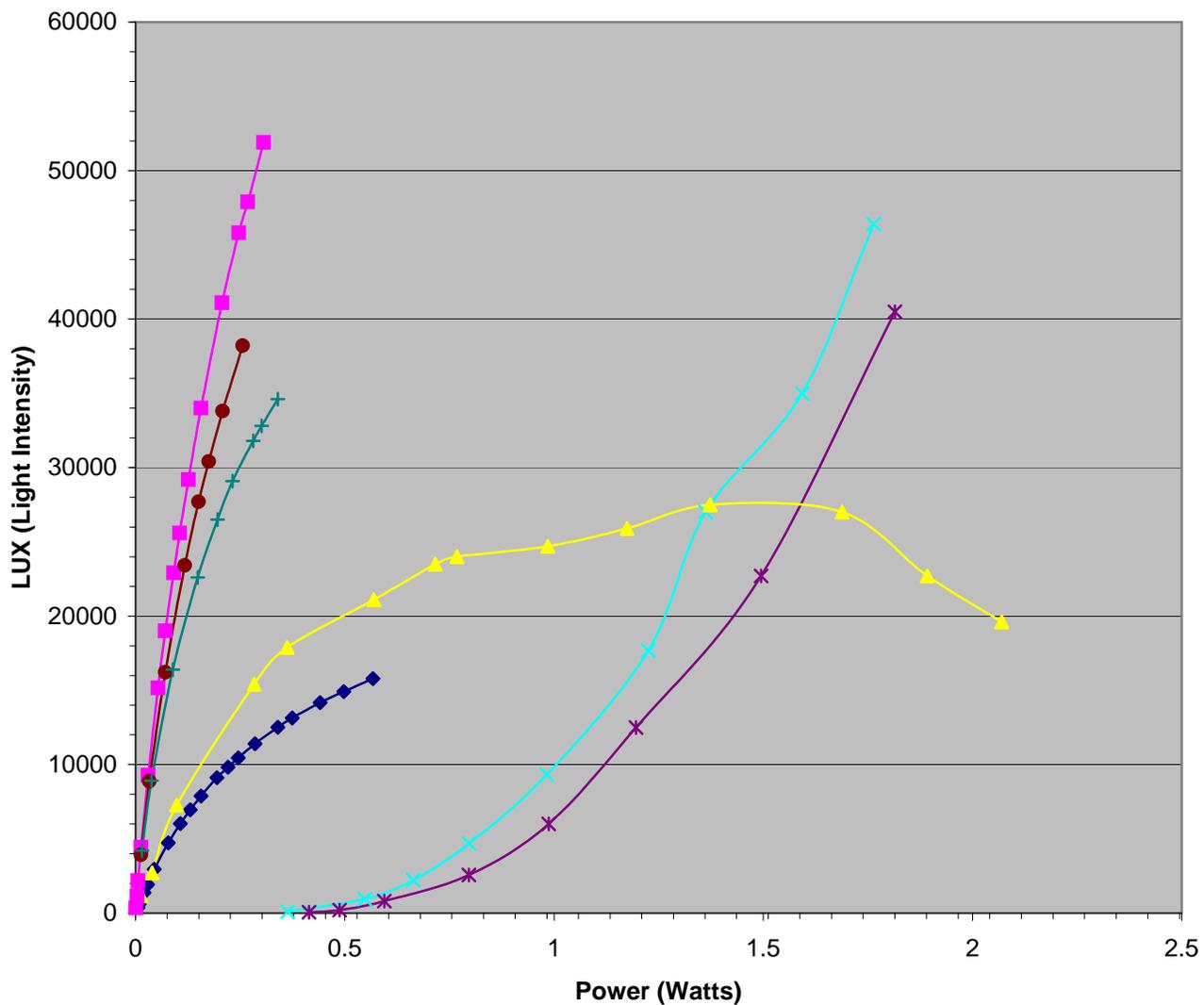


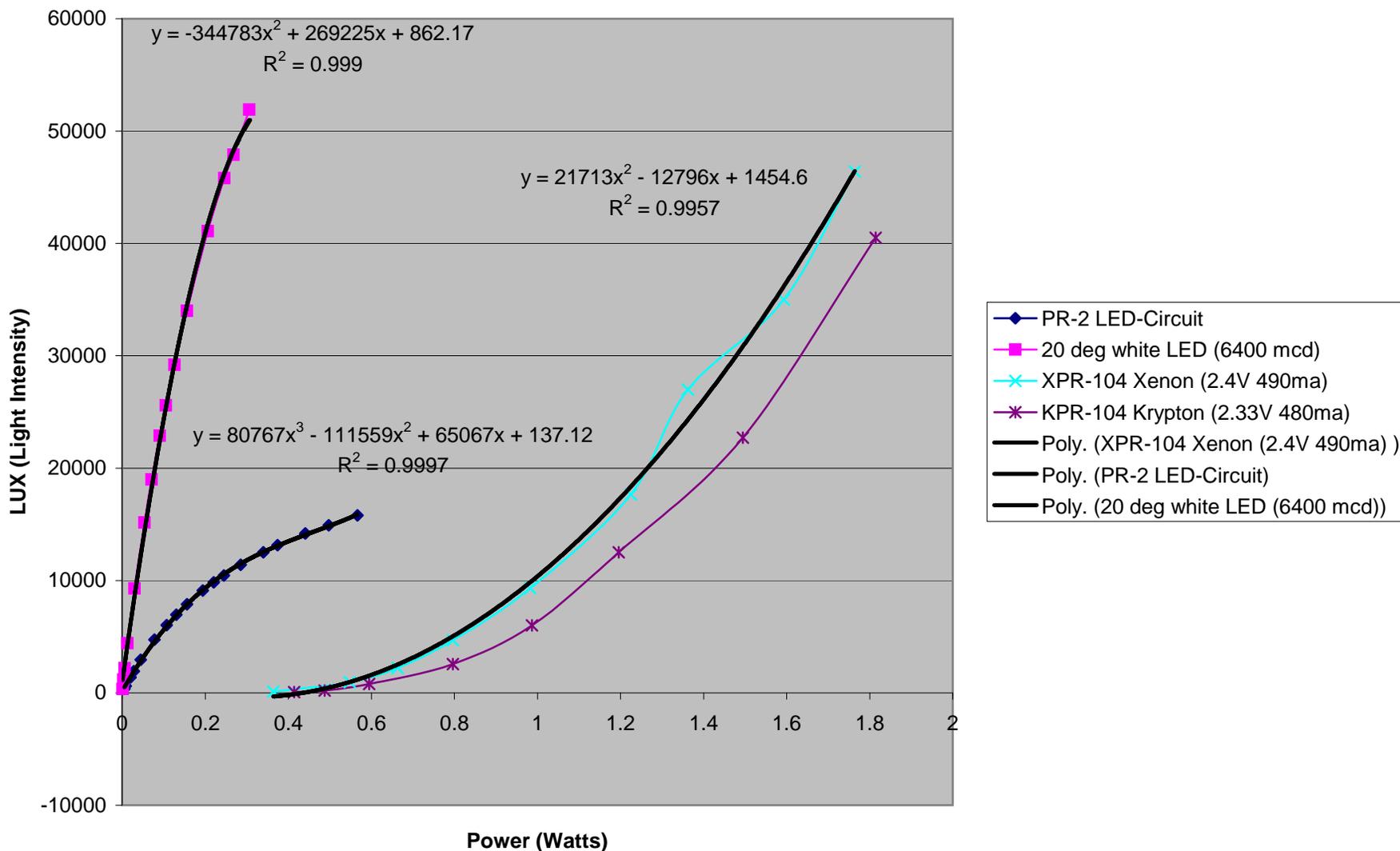
White Light Single LEDs and Flash Light Bulbs (2 AA) Comparison



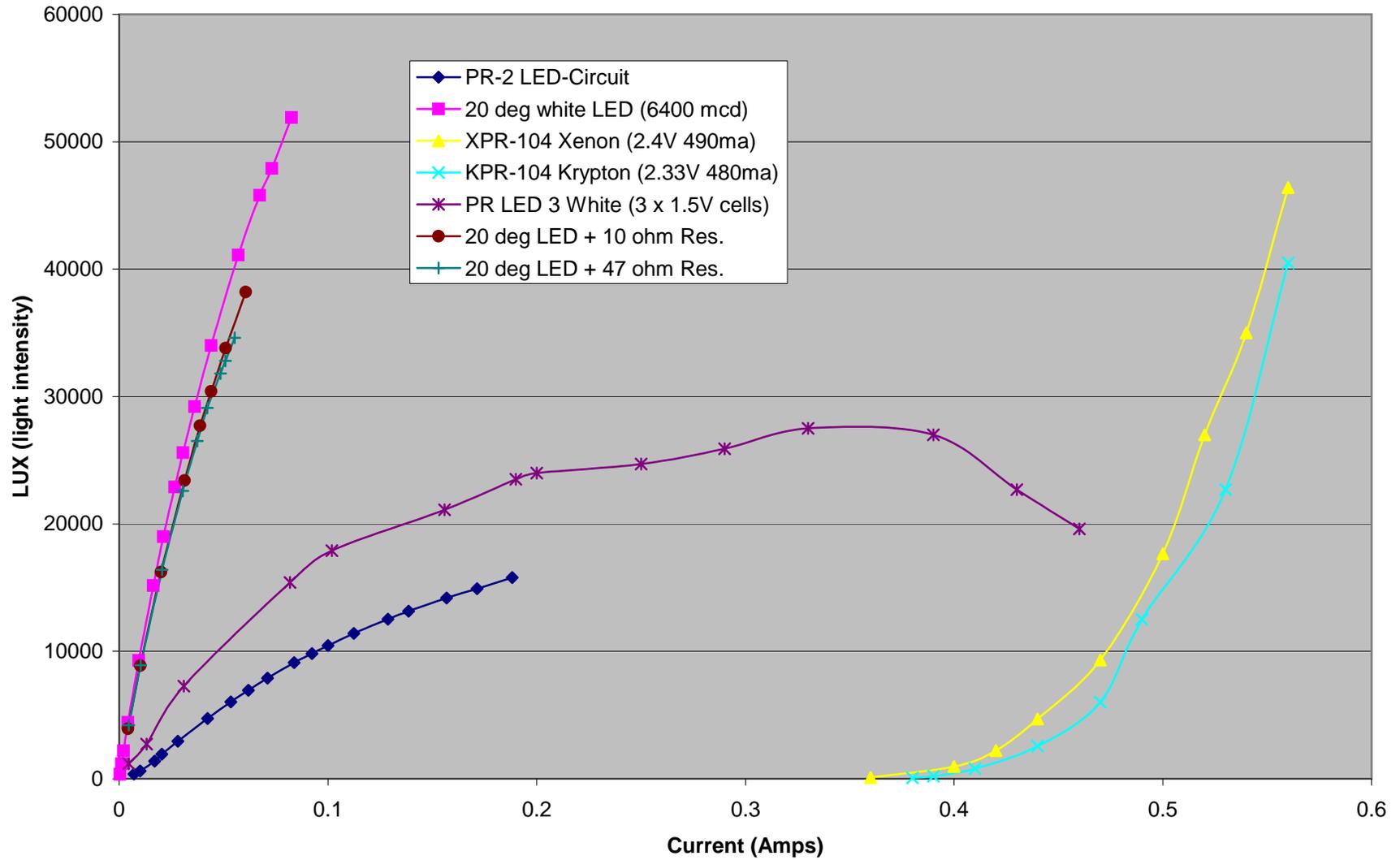
Power for LED's and Flashlight Bulbs



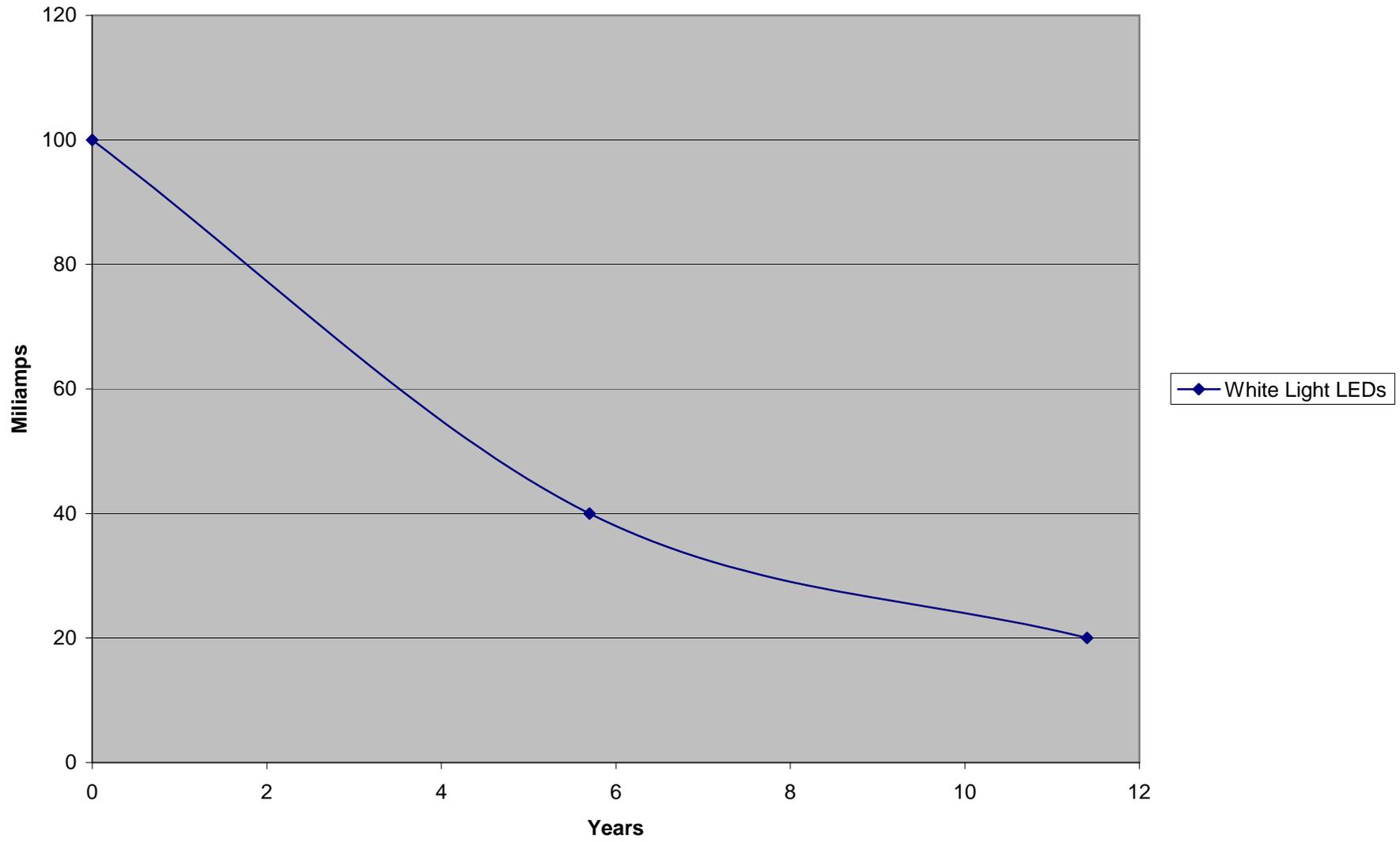
Power for LED's and Flashlight Bulbs



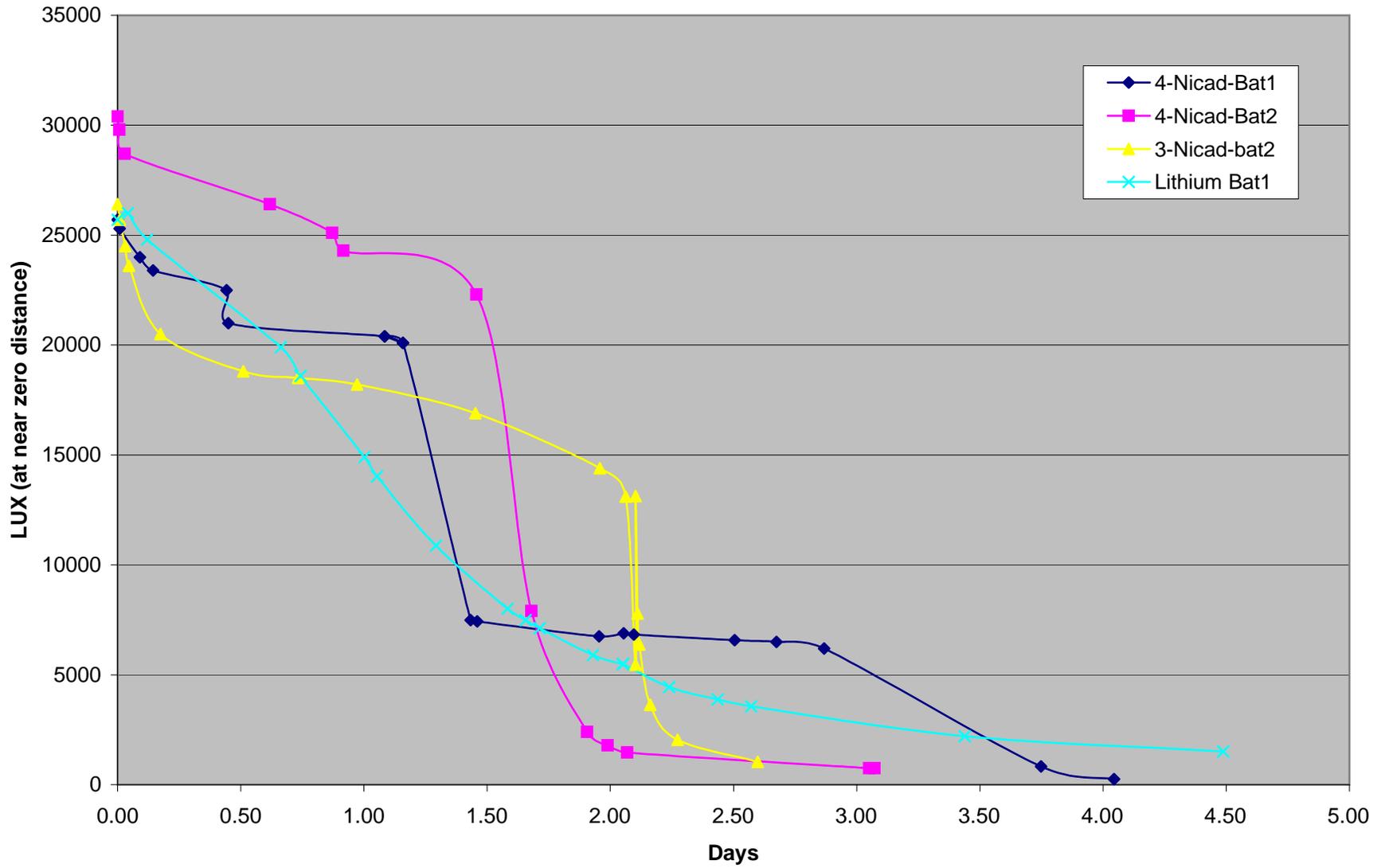
Current for Flashlight Bulbs and LEDs



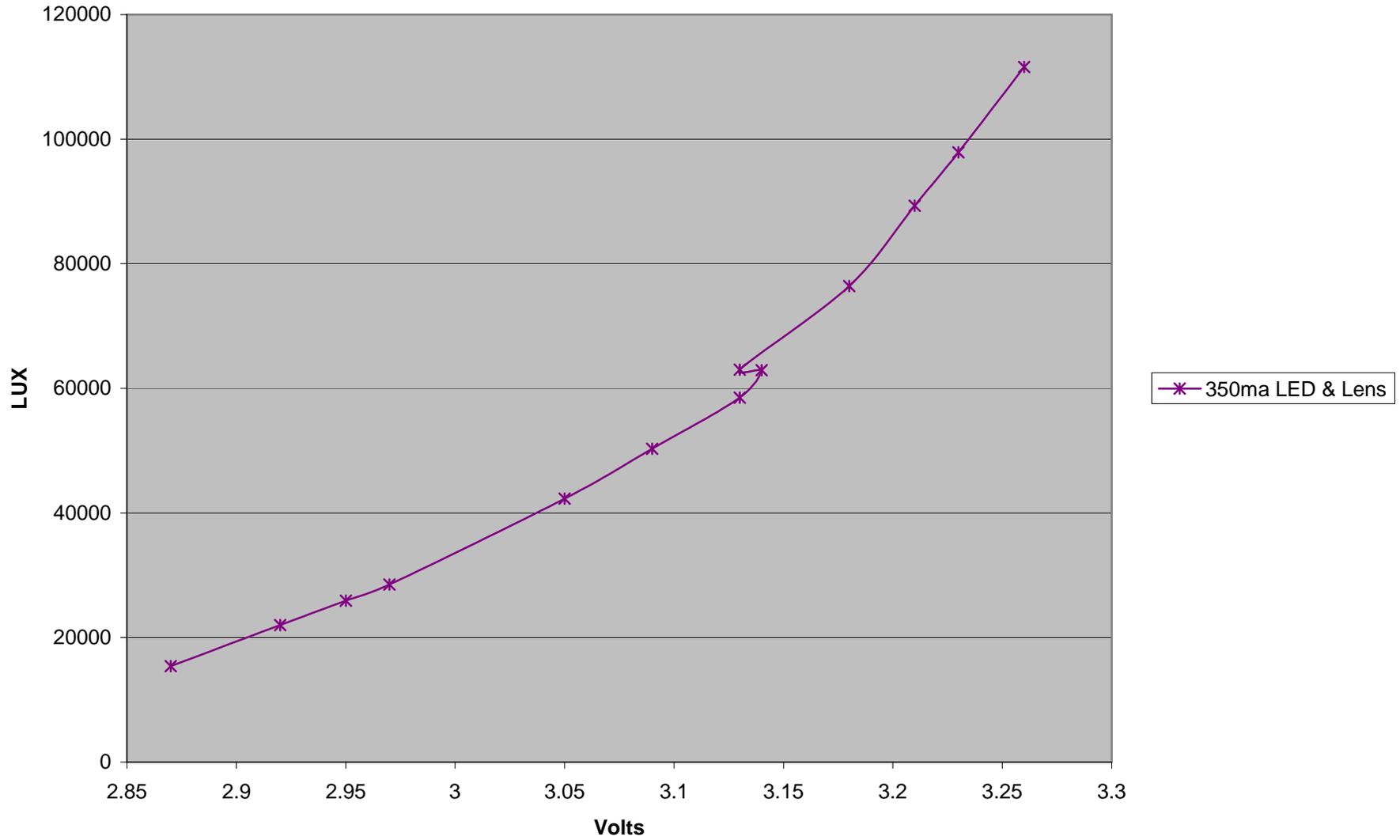
LED Estimated Life



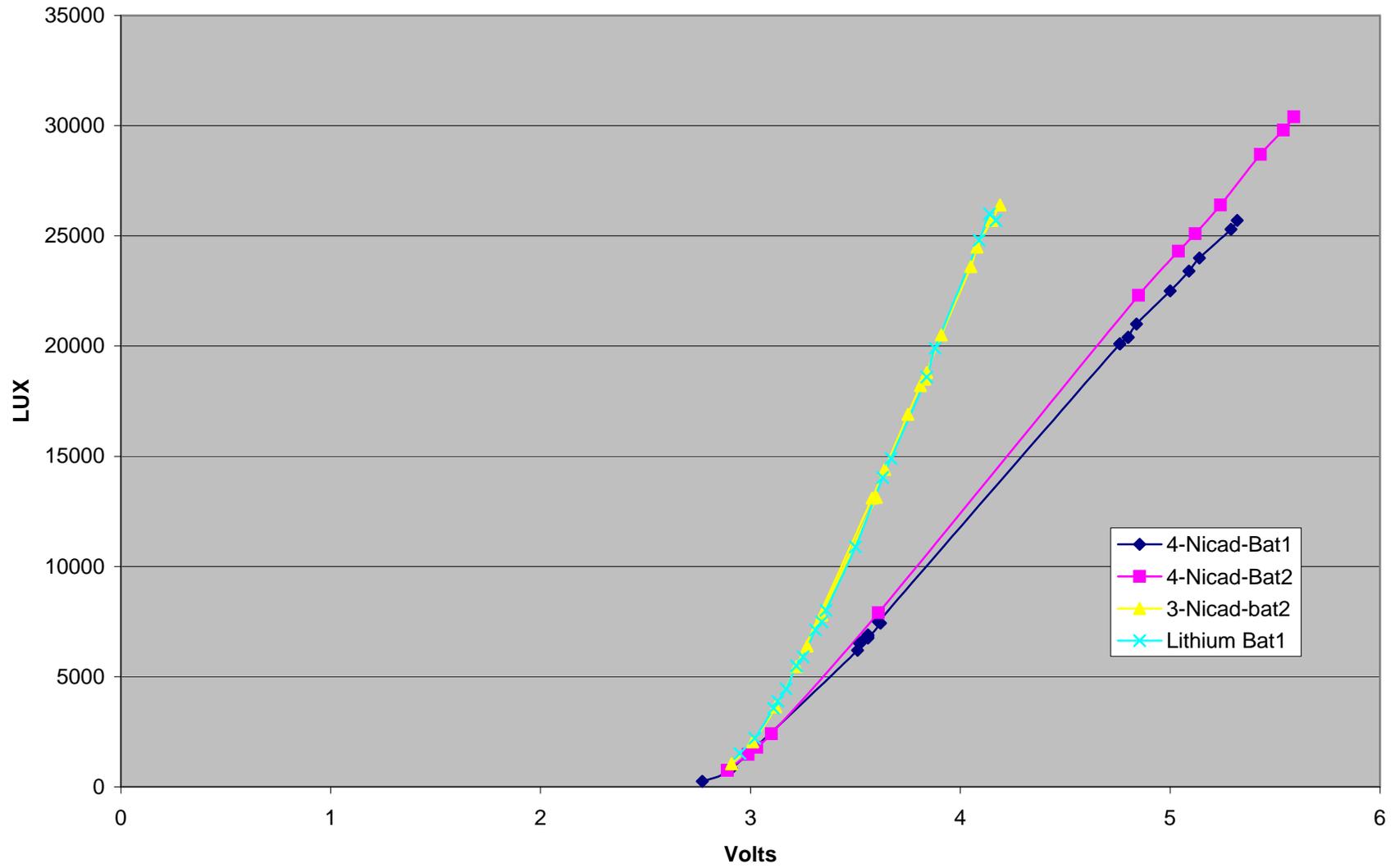
4-Cell 1.1 Amp-Hr Nicad White Light LED



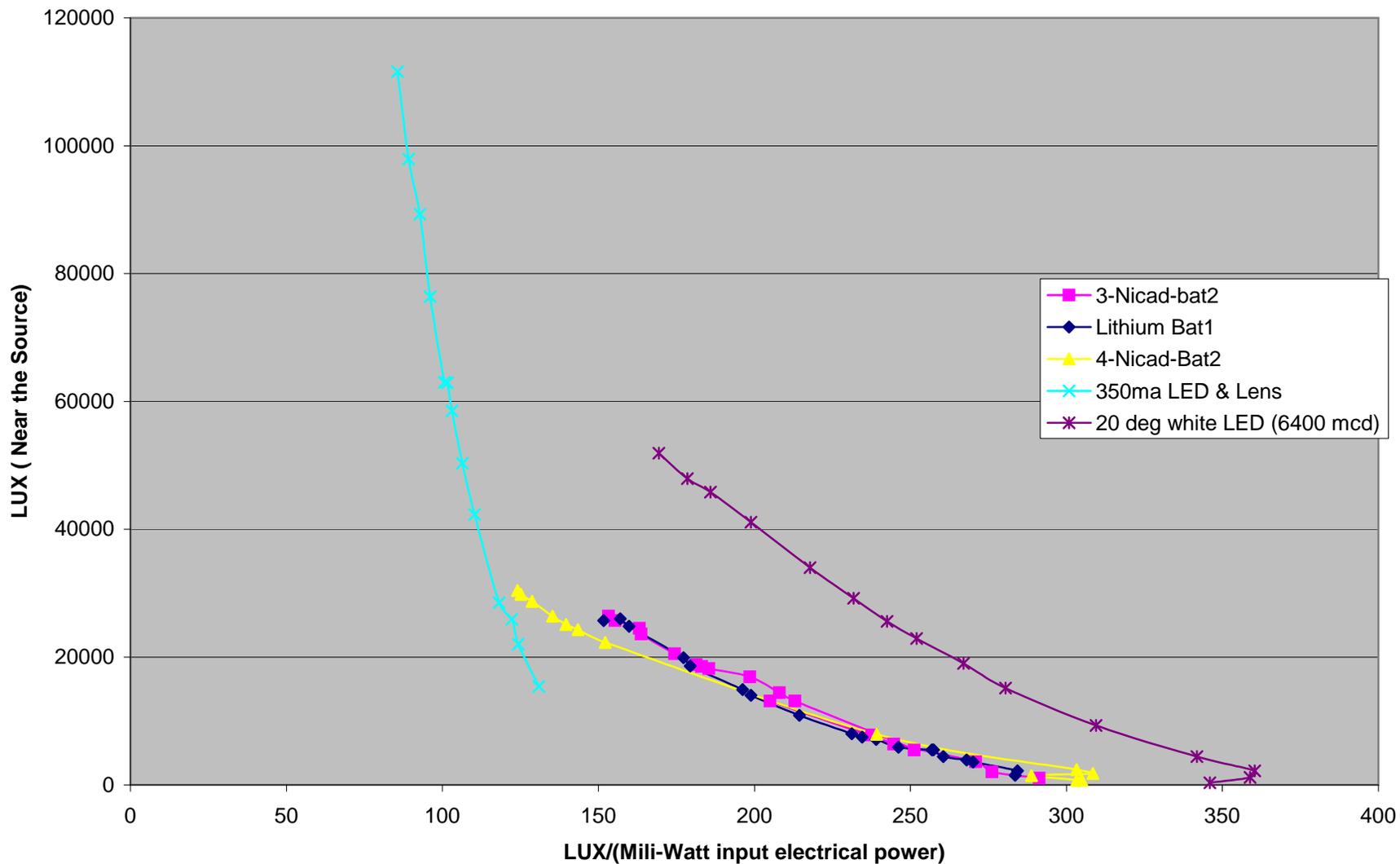
350 Ma White LED with Lens



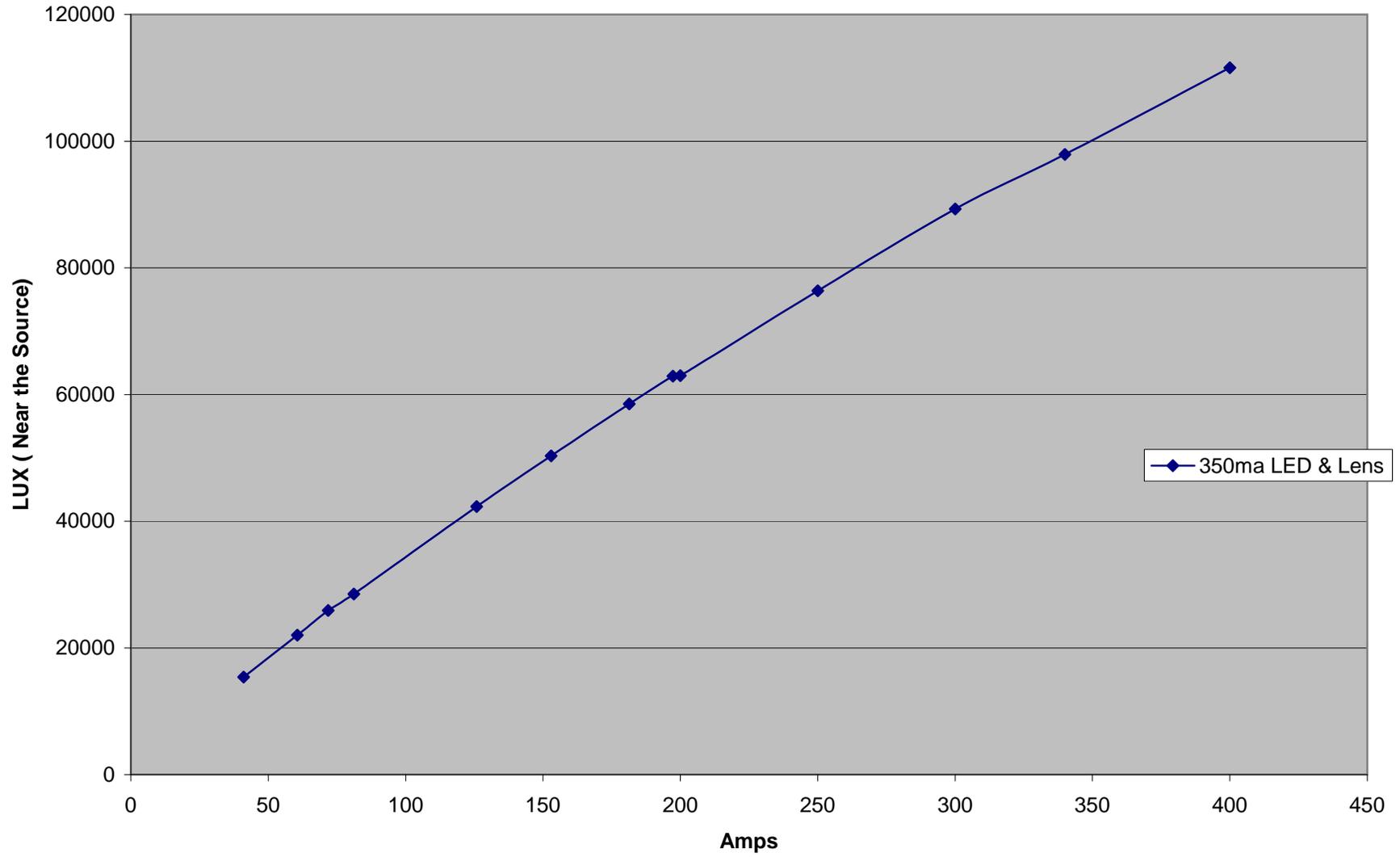
4 cell NiCad with 47 ohm and white 20 deg LED



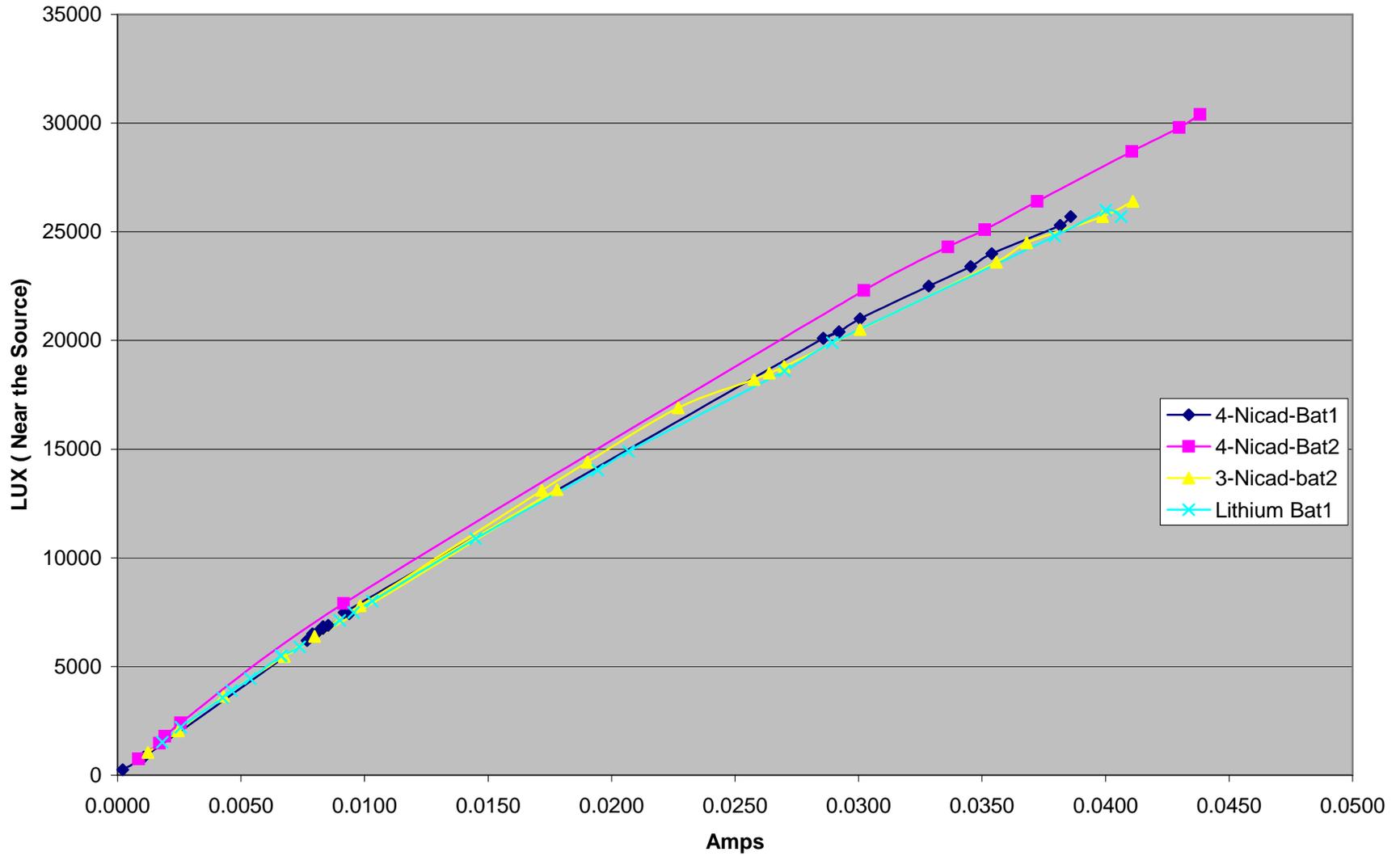
Efficiency



350 Ma White LED with Lens



4-Cell NiCad with LED and 47 Ohm R



Across bulb				LUX	Type bulb	Bat type	No of Cells	Min volt
Voltage	Amps	Power	LUX			Nicad		
0.77	0.007	0.00539		365 PR-2 LED-Circuit			1	1
0.88	0.01	0.0088		607 PR-2 LED-Circuit			2	2
1.2	0.0169	0.02028		1383 PR-2 LED-Circuit			3	3
1.39	0.0204	0.028356		1920 PR-2 LED-Circuit			4	4
1.59	0.0281	0.044679		2950 PR-2 LED-Circuit			5	5
1.84	0.0423	0.077832		4730 PR-2 LED-Circuit			6	6
2	0.0535	0.107		6030 PR-2 LED-Circuit			7	7
2.11	0.0619	0.130609		6950 PR-2 LED-Circuit			8	8
2.2	0.0711	0.15642		7890 PR-2 LED-Circuit			9	9
2.32	0.0838	0.194416		9120 PR-2 LED-Circuit			10	10
2.39	0.0923	0.220597		9830 PR-2 LED-Circuit		Alicloy	1	1
2.45	0.1	0.245		10450 PR-2 LED-Circuit			2	2
2.54	0.1124	0.285496		11410 PR-2 LED-Circuit			3	3
2.64	0.1287	0.339768		12520 PR-2 LED-Circuit			4	4
2.7	0.1387	0.37449		13150 PR-2 LED-Circuit			5	5
2.81	0.1569	0.440889		14180 PR-2 LED-Circuit			6	6
2.9	0.1715	0.49735		14920 PR-2 LED-Circuit			7	7
3.01	0.1883	0.566783		15790 PR-2 LED-Circuit			8	8
							9	9
						white LED	1	2.8

Voltage	Amps	Power	LUX	Type bulb
0.666	0.004	0.002664		310 not plotted
0.887	0.0103	0.009136		1620 PR-2 LED
1.111	0.0153	0.016998		2880 PR-2 LED
1.575	0.0273	0.042998		7580 PR-2 LED
1.921	0.0458	0.087982		13350 PR-2 LED
2.33	0.0788	0.183604		26200 PR-2 LED
2.38	0.082	0.19516		28300 PR-2 LED
2.466	0.0933	0.230078		31300 PR-2 LED
2.55	0.1032	0.26316		33500 PR-2 LED
2.59	0.106	0.27454		34100 PR-2 LED
2.602	0.1069	0.278154		35000 PR-2 LED
2.872	0.1483	0.425918		44300 PR-2 LED
2.99	0.174	0.52026		47800 PR-2 LED
3.03	0.184	0.55752		48300 PR-2 LED
3.13	0.2	0.626		51000 PR-2 LED

Uses circuit to keep light constant ver voltage
 First measurement that were in error some how
 don't use

typical nicad voltage max

Voltage	Amps	Power	LUX	Type bulb	
3.109	0.0073	0.022696		4320	not plotted
3.178	0.0103	0.032733		5920	21 deg white LED (6400 mcd) Old data not enough range
3.18	0.0103	0.032754		6850	22 deg white LED (6400 mcd)
3.3	0.0182	0.06006		9740	23 deg white LED (6400 mcd)
3.32	0.0198	0.065736		10440	24 deg white LED (6400 mcd)
3.36	0.024	0.08064		12230	25 deg white LED (6400 mcd)
3.42	0.0303	0.103626		14840	26 deg white LED (6400 mcd)
3.46	0.0352	0.121792		16670	27 deg white LED (6400 mcd)
3.51	0.0418	0.146718		19080	28 deg white LED (6400 mcd)
3.57	0.0519	0.185283		22500	29 deg white LED (6400 mcd)
3.66	0.0688	0.251808		27400	30 deg white LED (6400 mcd)
3.66	0.0686	0.251076		31800	31 deg white LED (6400 mcd)

2nd run

Voltage	Amps	Power	LUX	Type bulb	Lux/miliwatt
2.77	0.00036	0.000997		345	20 deg white LED (6400 mcd) 346
2.88	0.00113	0.003254		1168	plotted yes 359
2.95	0.00206	0.006077		2190	360
3.05	0.00424	0.012932		4420	342
3.19	0.0094	0.029986		9280	309
3.31	0.01633	0.054052		15160	280
3.36	0.02118	0.071165		19000	267
3.42	0.02657	0.090869		22900	252
3.45	0.0306	0.10557		25600	242
3.49	0.0361	0.125989		29200	232
3.54	0.0441	0.156114		34000	218
3.62	0.0571	0.206702		41100	199
3.66	0.0673	0.246318		45800	186
3.67	0.0731	0.268277		47900	179
3.71	0.0826	0.306446		51900	169

Voltage	Amps	Power	LUX	Type bulb
0.879	0.34	0.29886		33 not plotted
1.117	0.36	0.40212		181 KPR 104 14K Philips 2.2v .47A HK

1.371	0.39	0.53469	860 KPR 104 14K Philips 2.2v .47A HK
1.65	0.41	0.6765	2560 KPR 104 14K Philips 2.2v .47A HK
1.78	0.42	0.7476	3840 KPR 104 14K Philips 2.2v .47A HK
1.88	0.43	0.8084	4930 KPR 104 14K Philips 2.2v .47A HK
1.906	0.44	0.83864	5420 KPR 104 14K Philips 2.2v .47A HK
1.97	0.44	0.8668	6400 KPR 104 14K Philips 2.2v .47A HK
2.017	0.45	0.90765	7180 KPR 104 14K Philips 2.2v .47A HK
2.21	0.46	1.0166	10500 KPR 104 14K Philips 2.2v .47A HK
2.34	0.48	1.1232	13000 KPR 104 14K Philips 2.2v .47A HK

Voltage	Amps	Power	LUX	Type bulb
1.01	0.36	0.3636		103 XPR-104 Xenon (2.4V 490ma)
1.37	0.4	0.548		948 XPR-104 Xenon (2.4V 490ma)
1.58	0.42	0.6636		2220 XPR-104 Xenon (2.4V 490ma)
1.81	0.44	0.7964		4680 XPR-104 Xenon (2.4V 490ma)
2.09	0.47	0.9823		9320 XPR-104 Xenon (2.4V 490ma)
2.45	0.5	1.225		17660 XPR-104 Xenon (2.4V 490ma)
2.62	0.52	1.3624		27000
2.95	0.54	1.593		35000 XPR-104 Xenon (2.4V 490ma)
3.15	0.56	1.764		46400 XPR-104 Xenon (2.4V 490ma)

Voltage	Amps	Power	LUX	Type bulb
1.09	0.38	0.4142		64 KPR-104 Krypton (2.33V 480ma)
1.25	0.39	0.4875		200 KPR-104 Krypton (2.33V 480ma)
1.45	0.41	0.5945		800 KPR-104 Krypton (2.33V 480ma)
1.81	0.44	0.7964		2560 KPR-104 Krypton (2.33V 480ma)
2.1	0.47	0.987		6000 KPR-104 Krypton (2.33V 480ma)
2.44	0.49	1.1956		12500 KPR-104 Krypton (2.33V 480ma)
2.82	0.53	1.4946		22700 KPR-104 Krypton (2.33V 480ma)
3.24	0.56	1.8144		40500 KPR-104 Krypton (2.33V 480ma)

Voltage	Amps	Power	LUX	Type bulb
2.87	0.00455	0.013059		1170 PR LED 3 White (3 x 1.5V cells)
2.99	0.0131	0.039169		2710

3.19	0.0309	0.098571	7270
3.46	0.0818	0.283028	15400
3.55	0.1019	0.361745	17900
3.65	0.1559	0.569035	21100
3.77	0.19	0.7163	23500
3.84	0.2	0.768	24000
3.94	0.25	0.985	24700
4.05	0.29	1.1745	25900
4.16	0.33	1.3728	27500
4.33	0.39	1.6887	27000
4.4	0.43	1.892	22700
4.5	0.46	2.07	19600

Voltage	Amps	Power	LUX	Type bulb
1.95	0.75	1.4625		6000 K2 J2.4V Krypton
1.98	0.77	1.5246		1400 not plotted

Voltage	Amps	Power	LUX	Type bulb
3.07	0.0042	0.012894		3920 20 deg LED + 10 ohm Res.
3.29	0.01012	0.033295		8880
3.54	0.02011	0.071189		16210
3.76	0.03135	0.117876		23400
3.88	0.0388	0.150544		27700
3.97	0.0441	0.175077		30400
4.08	0.051	0.20808		33800
4.22	0.0606	0.255732		38200

Voltage	Amps	Power	LUX	Type bulb
3.26	0.00452	0.014735		4210 20 deg LED + 47 ohm Res.
3.68	0.01025	0.03772		8920
4.31	0.02057	0.088657		16400
4.86	0.0305	0.14823		22600
5.23	0.0374	0.195602		26500
5.48	0.0422	0.231256		29100
5.8	0.0485	0.2813		31800
5.92	0.0509	0.301328		32800

6.14 0.0553 0.339542 34600

Voltage	Amps	Power	LUX	Type bulb
3.05	0.00427	0.013024		3980 20 deg LED + 0 ohm Res.
3.35	0.02033	0.068106		9200
3.45	0.03149	0.108641		23600
3.52	0.0388	0.136576		27800
3.56	0.044	0.15664		30500
3.59	0.0509	0.182731		34000
3.64	0.0604	0.219856		38400

4-Nicad-Bat1

20 deg White LED + 47 ohm R + 1.248 amp-hr to charge this at end state.

4 Cell Battery rated as 1.111 amp-hr on refresh (oc

Bat V	Res V	Days	Time meas delta from start	Time in days	Resistor of power	Cum Lux	end volts each cell	with 2x47 o Light outpu
5.32	1.81	17-Apr-02	0.00	0.0386	46.9	0	25700	1.201
5.29	1.79	17-Apr-02	0.01	0.0382	0.20360341	25300	0.044	Current goe
5.14	1.66	17-Apr-02	0.09	0.0354	0.39541311	24000	0.365	
5.09	1.62	17-Apr-02	0.14	0.0345	0.57427452	23400	1.186	
5	1.54	18-Apr-02	0.44	0.0328	0.74423401	22500		
4.84	1.41	18-Apr-02	0.45	0.0301	0.89896748	21000		
4.8	1.37	18-Apr-02	1.08	0.0292	1.04182036	20400		
4.76	1.34	18-Apr-02	1.16	0.0286	1.17992058	20100		
4.8	1.37	18-Apr-02	1.08	0.0292	1.31802079	20400		
4.76	1.34	18-Apr-02	1.16	0.0286	1.456121	20100		
3.61	0.43	19-Apr-02	1.43	0.0092	1.53509168	7490		
3.62	0.44	19-Apr-02	1.46	0.0094	1.568621	7430		
3.56	0.39	19-Apr-02	1.95	0.0083	1.60038753	6750		
3.56	0.4	19-Apr-02	2.05	0.0085	1.63037047	6890		
3.56	0.39	19-Apr-02	2.10	0.0083	1.66035341	6830		
3.53	0.38	20-Apr-02	2.50	0.0081	1.68945416	6580		
3.52	0.37	20-Apr-02	2.67	0.0079	1.71763913	6500		
3.51	0.36	20-Apr-02	2.87	0.0077	1.74499467	6200		
2.91	0.05	21-Apr-02	3.75	0.0011	1.75902559	830		
2.77	0.01	21-Apr-02	4.04	0.0002	1.76084222	249		

Estimated LED life time curve

White Light LEDs

years	ma current
11.4	20
5.7	40
0	100

not plotted yet -----

350ma LED & Lens

New large 350 ma white LED with lens

MA	Lux	LED volts	power (mili-watts)	Lux/Mili-watt
41	15400	2.87	118	131
60.6	22000	2.92	177	124
71.8	25900	2.95	212	122
81.2	28500	2.97	241	118
125.8	42300	3.05	384	110
153	50300	3.09	473	106
181.4	58500	3.13	568	103
197.3	62900	3.14	620	102
200	63000	3.13	626	101
250	76400	3.18	795	96
300	89300	3.21	963	93
340	97900	3.23	1098	89
400	111600	3.26	1304	86

Lithium Bat1

Resistance = 16 ohms 16

Lithium 1200 amp-hr Battery light output curve for 20ma white 20 degree LED

LUX	Bat-Volts	Res-Volts	Current	Date-time	Time	Lux/miliwatt
25700	4.17	0.65	0.0406	5/3/02 7:35 PM	0.000	152
26000	4.14	0.64	0.0400	5/3/02 8:35 PM	0.042	157
24800	4.09	0.607	0.0379	5/3/02 10:29 PM	0.121	160
19900	3.88	0.463	0.0289	5/4/02 11:29 AM	0.663	177
18600	3.84	0.432	0.0270	5/4/02 1:25 PM	0.743	179
14900	3.67	0.331	0.0207	5/4/02 7:37 PM	1.001	196
14030	3.63	0.311	0.0194	5/4/02 8:52 PM	1.053	199

10880	3.5	0.232	0.0145	5/5/02 2:35 AM	1.292		214	
8010	3.36	0.165	0.0103	5/5/02 9:35 AM	1.583		231	
7490	3.34	0.153	0.0096	5/5/02 11:20 AM	1.656		235	
7120	3.31	0.144	0.0090	5/5/02 12:43 PM	1.714		239	
5900	3.25	0.118	0.0074	5/5/02 5:53 PM	1.929		246	
5480	3.22	0.106	0.0066	5/5/02 8:48 PM	2.051	off or rest for	0.525	257
5490	3.22	0.106	0.0066	5/6/02 9:24 AM	2.051		257	
4440	3.17	0.086	0.0054	5/6/02 1:55 PM	2.239		261	
3880	3.13	0.074	0.0046	5/6/02 6:39 PM	2.436		268	
3570	3.11	0.068	0.0043	5/6/02 9:54 PM	2.572		270	
2200	3.02	0.041	0.0026	5/7/02 6:42 PM	3.438		284	
1516	2.95	0.029	0.0018	5/8/02 7:54 PM	4.488		284	

4-Nicad-Bat2

res47ohm 47

Test with a new 4 cell nicad and 20 degree LED 20 ma white 1608 full change refresh 1178 (47ohms I think)

LUX	Bat-Volts	Res-Volts	Current	Date-time	Time	Lux/miliwatt
0	5.62	0	0.0000			
30400	5.59	2.06	0.0438	4/25/02 9:21 PM	0.000	124
29800	5.54	2.02	0.0430	4/25/02 9:31 PM	0.007	125
28700	5.43	1.93	0.0411	4/25/02 10:03 PM	0.029	129
26400	5.24	1.75	0.0372	4/26/02 12:11 PM	0.618	135
25100	5.12	1.65	0.0351	4/26/02 6:15 PM	0.871	140
24300	5.04	1.58	0.0336	4/26/02 7:20 PM	0.916	143
22300	4.85	1.42	0.0302	4/27/02 8:18 AM	1.456	152
7900	3.61	0.43	0.0091	4/27/02 1:40 PM	1.680	239
2400	3.1	0.12	0.0026	4/27/02 7:06 PM	1.906	303
1790	3.03	0.09	0.0019	4/27/02 9:06 PM	1.990	309
1470	2.99	0.08	0.0017	4/27/02 11:00 PM	2.069	289
750	2.89	0.04	0.0009	4/28/02 10:34 PM	3.051	305
746	2.89	0.04	0.0009	4/28/02 11:05 PM	3.072	303

3-Nicad-bat2

res16.3ohn 16.3

Test of 3 nicad cells (16.3 ohms) 20 degree 20 ma white LED

LUX	Bat-Volts	Res-Volts	Current	Date-time	Time	Lux/miliwatt
26400	4.19	0.67	0.0411	4/28/02 7:51 PM	0.000	153

25700	4.15	0.65	0.0399	4/28/02 8:04 PM	0.009		155
24500	4.08	0.6	0.0368	4/28/02 8:36 PM	0.031		163
23600	4.05	0.58	0.0356	4/28/02 8:58 PM	0.047		164
20500	3.91	0.49	0.0301	4/29/02 12:02 AM	0.174		174
18800	3.84	0.44	0.0270	4/29/02 8:05 AM	0.510		181
18500	3.83	0.43	0.0264	4/29/02 1:25 PM	0.732		183
18200	3.81	0.42	0.0258	4/29/02 7:11 PM	0.972		185
16900	3.75	0.37	0.0227	4/30/02 6:42 AM	1.452		199
14400	3.64	0.31	0.0190	4/30/02 6:49 PM	1.957		208
13100	3.58	0.28	0.0172	4/30/02 9:21 PM	2.063		213
5460	3.22	0.11	0.0067	4/30/02 10:18 PM	2.102	off for a rest	251
13130	3.6	0.29	0.0178	5/1/02 6:55 PM	2.102	0.859	205
7790	3.34	0.16	0.0098	5/1/02 7:07 PM	2.110		238
6380	3.27	0.13	0.0080	5/1/02 7:18 PM	2.118		245
3630	3.12	0.07	0.0043	5/1/02 8:21 PM	2.162		271
2040	3.01	0.04	0.0025	5/1/02 11:01 PM	2.273		276
1040	2.91	0.02	0.0012	5/2/02 6:49 AM	2.598		291

working Av	Max volt	No of LED:	Min volt	working Av	Max volt	#Nicaid	Cel Res	LowV	Res wrkV	Res highV	Opt Res
1.2	1.35	white LED	1	2.8	3.4	3.6	3	0	8	9	10
2.4	2.7						4	1200	56	36	47
3.6	4.05		2	5.6	6.8	7.2	6				
4.8	5.4		3	8.4	10.2	10.8	9				
6	6.75		4	11.2	13.6	14.4					
7.2	8.1		5	14	17	18					
8.4	9.45		6	16.8	20.4	21.6	#alaliy				
9.6	10.8		7	19.6	23.8	25.2	3	200	26	24	22
10.8	12.15		8	22.4	27.2	28.8					
12	13.5		9	25.2	30.6	32.4					
1.35	1.6		10	28	34	36					
2.7	3.2		11	30.8	37.4	39.6					
4.05	4.8		12	33.6	40.8	43.2					
5.4	6.4										
6.75	8										
8.1	9.6										
9.45	11.2										
10.8	12.8										
12.15	14.4										
3.4	3.6										
				ma	ma	ma					
		Assumptioi	0.001	0.025	0.05						

full 5.52-5.44 volts)

ghm

it ratio .595 Less

es to .530 Less

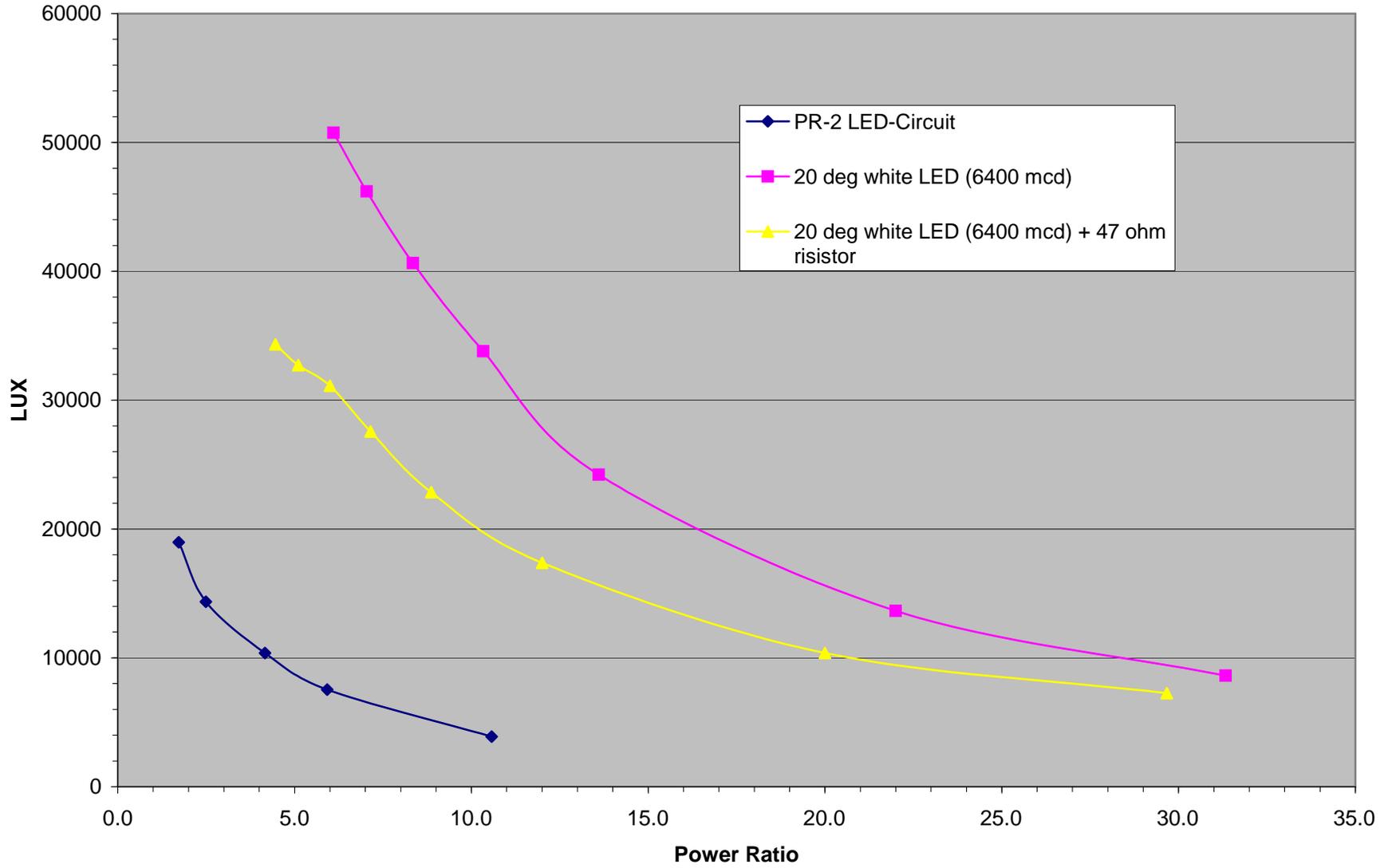
#Ala cells

3

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8

Power Usage Ratio For Xenon Bulb Devided by Several Test LED Configurations



PR-2 LED-Circuit		Xenon bulb		LUX Ratio LED to Xenon	
Power	Lux	Power	Lux	Power ratio for Xenon to LED at same light intensities	
-0.112	-8907	0.52	672		
-0.024	-1845	0.62	1868		
0.07	3850	0.74	3876	10.6	3876
0.152	7520	0.9	7526	5.9	7526
0.24	10383	1	10372	4.2	10372
0.45	14347	1.12	14360	2.5	14360
0.72	18551	1.24	18973	1.7	18973
20 deg white LED (6400 mcd)					
0.03	8629	0.94	8612	31.3	8612
0.05	13461	1.1	13652	22.0	13652
0.1	24337	1.36	24212	13.6	24212
0.15	33488	1.55	33786	10.3	33786
0.2	40916	1.67	40641	8.4	40641
0.25	46619	1.76	46192	7.0	46192
0.3	50599	1.83	50753	6.1	50753
20 deg white LED (6400 mcd) + 47 ohm resistor					
0.03	7367	0.89	7265	29.7	7265
0.05	10337	1	10372	20.0	10372
0.1	17009	1.2	17366	12.0	17366
0.15	22605	1.33	22844	8.9	22844
0.2	27125	1.43	27557	7.2	27557
0.25	30570	1.5	31115	6.0	31115
0.3	32940	1.53	32705	5.1	32705
0.35	34233	1.56	34334	4.5	34334

Total light output measurments			K-Lm (Lm/ma)		Ksphere	
			17.143	83.5		
mike"s unit		Input	Output	Output	Lm per	Discription
Volts	Amps	power	In ma	light in lumens	InputWatt	
2.44	0.47	1.1468	1.1	18.8573	16.44341	KPR 104 2.2V .47A Kription gas
3.32	0.02	0.0664	0.0716	1.227439	18.48552	20degree White LED with reflector
3.5	0.0401	0.14035	0.125	2.142875	15.26808	20degree White LED with reflector
3	0.1	0.3	0.397	6.805771	22.6859	Large 350ma white LED no rellector
3.27	0.25	0.8175	0.82	14.05726	17.19543	Large 350ma white LED no rellector
3.3	0.35	1.155	1.05	18.00015	15.58455	Large 350ma white LED no rellector
Rons unit			16.36364			
3.15	0.35	1.1025	1.1	18	16.32653	